Developing mathematics in Secondary Schools
Headteachers talk about creating and sustaining excellent mathematics departments
Contents

Foreword 1
Introduction 2
Executive Summary 4
1. What mathematics brings to students and to the school 6
2. Recruiting teachers of mathematics 9
3. Retention 12
4. Continuing Professional Development (CPD) 15
5. Leadership and Management 17
6. Next Steps 19
Appendix 1 Participating Schools 20
Appendix 2 Top Tips 25
One of the greatest challenges facing headteachers is the recruitment and retention of good mathematics teachers. The situation, whilst particularly acute in our inner cities is also to be found in rural areas. The National Centre for Excellence in the Teaching of Mathematics (NCETM) commissioned a case study in 2008 based in seven challenging inner-city schools to examine how leaders have found local solutions to national problems, especially in the area of recruitment and retention of mathematics staff. This case study, ‘Developing mathematics in London Secondary Schools’ was well received and the NCETM decided to widen the remit to include a wider range of schools nationally.

This document is the result of the wider study. The strategies identified are very similar to those in the first case study and many of the local solutions seem independent of location and school type. It forms a crucial part of our ongoing work with school leaders and discusses the strategies employed by diverse a group of senior leaders in developing and sustaining good mathematics departments, often in challenging circumstances.

The NCETM aims to support teaching and learning in mathematics by improving the quality and availability of professional development for all teachers of mathematics. Our approach is to identify, share and develop good practice and expertise wherever it exists. The NCETM believes that school leadership is a vital component in developing successful teaching and learning in the mathematics, so an important part of its remit is to work collaboratively with senior leaders in schools to find ways to improve mathematics provision. These two studies form part of this strand of the NCETM’s work.

The NCETM works with many different stakeholders, from initial teacher education to senior leadership, with the aim of ensuring that the workforce of mathematics teachers has the opportunity to grow and learn professionally. We are certain that it is only by this collaborative effort that we can provide the best mathematics education for our young people. This study is only a part of our work with senior leaders: for example, the NCETM has already produced a leaflet on ‘Improving whole school CVA through the mathematics faculty’ and for the FE sector, a report entitled ‘The organisation of mathematics in colleges.’ We are also intending to extend our work into the primary phase. The central role of headteachers in the development of mathematics education is unquestionable. We would welcome ideas and feedback as to how we can disseminate and elaborate this important message. For more information please contact us by visiting the NCETM portal www.ncetm.org.uk or email info@ncetm.org.uk.

Professor Celia Hoyles OBE
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In *Making Mathematics Count*, the Inquiry into post-14 mathematics education (Feb 2004), Professor Adrian Smith highlights a number of challenges, one of the greatest of which is the shortage of qualified teachers of mathematics. Smith paints a picture of a high level of vacancies in mathematics posts¹, a decline in the number of new undergraduate trainees², high levels of unfilled places on secondary mathematics training courses³ and a worrying high proportion of teachers without appropriate qualifications⁴ in mathematics.

**The London Study**
Initially, we selected seven schools from London as part of a study of how schools create, develop and sustain good mathematics departments in the circumstances described above. The schools all face challenging circumstances with most of them situated in areas of high social priority, with above average free school meals and significantly high levels of EAL (English as an Additional Language). All of the schools are situated in areas where house prices are high and staff recruitment is an issue. Six headteachers and one deputy head were interviewed in depth about how they have developed their mathematics department, increased levels of attainment in mathematics and ensured a healthy supply of mathematics teachers. Following the interviews, a focus group of all seven senior leaders and several members of the National Centre for Excellence in the Teaching of Mathematics (NCETM) was held.

**Extending the study**
Whilst we are confident that the strategies and approaches are not particular to the schools in the London study, the fact that all seven schools were inner city schools in one area of London, prompted us to explore practice across a wider range of schools. A further seven schools across the country were identified as having mathematics provision that indicates good and/or improving practice that will be of interest to other schools seeking to improve their own provision. These seven schools range from being fairly small to very large, some with sixth forms, some taking students from age 11, others from age 14 and serving a wide variety of different types of communities. While some of the schools have over time developed extremely successful mathematics departments others are at a different stage of the journey but without exception all are working proactively to attain standards of excellence in mathematics across the school.

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² 190 in 1999 falling to 100 by 2004 (Making Mathematics Count 2004)
⁴ 24% of mathematics teachers with ‘weak’ or no qualifications in the subject (Making Mathematics Count 2004)
This study highlights strategies that are being adopted by these schools and their headteachers to find a way to address the issues of shortage, retention and mathematical qualification. Although these strategies do not provide solutions to the challenges that are faced at national level, they do present localised solutions through which the senior leadership of a school endeavours to ensure that the students in their care are not unnecessarily disadvantaged.

In this report we have gathered these strategies together and present them for consideration by any school seeking to meet these challenges. Although not every strategy or approach will suit every school, we are confident that for many schools some of the ideas included have the potential to transform mathematics. We are not presenting one big idea that will solve every problem schools face, we are exploring a whole series of smaller ideas – but smaller ideas that have been shown to work. All the schools felt that these ‘little’ ideas add up to a much greater whole that really does begin to meet the very significant challenges that schools face in mathematics. However what underlies the success of these strategies is the absolute commitment from the headteacher to drive forward improvement in mathematics. It is open-mindedness and resolve on everyone’s part that makes the difference.
Executive Summary

What mathematics brings to students and to the school
In all the schools surveyed, parents and students judge mathematics as a valuable subject to study, as it provides diverse career paths and contributes significantly to society. It is regarded as both servant and queen, offering significant support to other subjects yet also being enjoyed as a pursuit of learning in its own right. It is also seen as a subject that helps to develop personal confidence and academic rigour and, in addition, offers a chance for students with EAL to succeed while they work on their own language skills.

Recruitment
All schools see working with initial teacher training (ITT) institutions and teaching-practice students as a rich source of new teachers of mathematics. All the schools in the study offer a comprehensive mentoring system to support ITT students as well as emerging teachers and newly qualified teachers, many of the schools proactively encourage others involved in schools to become mathematics teachers. Most of the schools work closely with their governors, ensuring that there is support for strategies that help improve recruitment and retention in mathematics. These strategies include occasional overstaffing in the subject, encouraging collaborative practice, supporting teachers in joining national projects and generous promotions to keep staff within the school. The schools understand the value of a positive image of mathematics as a recruitment incentive. When recruitment proves difficult most of the schools are prepared to wait for the right candidate and have to strategies to cope in the interim.

Retention
There is an overriding theme of valuing the staff in all the schools in this study. There is also an emphasis on developing the mathematics department as a unit, setting clear but challenging targets for the teachers and ensuring that mathematics is well supported and resourced. Staff are encouraged to become involved in developmental work outside the school, for example to study for higher degrees. Good resourcing is recognised as being essential if staff are to be retained as is the pursuit of excellent working conditions. In addition, all the schools reported a culture of encouragement to apply for internal promotion. All the schools are flexible in their approach to staffing, supporting staff through changes in personal circumstances.
Continuing Professional Development (CPD)
All the schools place a great importance on constructive professional development. High quality CPD is seen as an entitlement for all staff. Schools reported a range of strategies including the use of experts, working with National Strategy consultants, collaborative practice projects and working on projects outside the school. It is agreed that CPD was very much seen as being a blend of these approaches. Many of the schools use coaching as an essential part of staff development and some take this to a high level.

Leadership and management
The head teachers emphasise the importance of establishing good communications between Senior Leaders and the mathematics department. All of the head teachers in the study articulate a clear vision for mathematics in their schools and see the importance of this being shared by the mathematics team. Role modelling is also highlighted by many of the head teachers as being a positive influence in the development of mathematics.
1. What mathematics brings to students and to the school

Each of the schools regards mathematics as an essential part of a student’s education. The role that GCSE Mathematics results play in the performance measurement of the school is of course recognised, and all of the schools work hard to ensure that their Contextual Value Added (CVA) is as high as possible, but the real value of mathematics lies well beyond these measures.

**Career value**
Both parents and students see mathematics as a valuable subject to study which provides good and diverse career pathways and which is recognised as a pre-requisite for university entrance. Everyday relevance and functionality as well as the ability to be numerate and logical in decision making is regarded as an essential part of a student’s education. Furthermore, mathematics is seen as a way of developing a set of highly valued skills such as problem solving, thinking skills and logical pathways. It is also prized for the contribution it makes to society and how it can be used to address and solve some of the problems facing us in the future.

**Connections with other subjects**
All of the schools also recognise the part that mathematics plays in the development of other subjects, especially STEM subjects (Science, Technology, Engineering and Mathematics), and it is seen as driving achievement in many other departments by the majority of headteachers in the case study. Some schools have made embedding mathematics into other subjects a priority, for example, one school has provided a ‘toolkit’ giving other subjects advice on teaching popular topics such as graphs; this is intended to assist other teachers with the mathematics that occurs naturally in their own subjects whilst moving towards a more consistent approach to the teaching of mathematical skills throughout the school. Another school has set up a whole school ‘numeracy committee’. In some of the most successful schools there is a culture of teaching topics together with other departments. There are examples where mathematics teachers work closely with Geography and Psychology teachers creating common themes. This has the effect of supporting the mathematics needed for learning in other areas as well as providing a ‘real life’ focus to the mathematics teaching. In one school mathematics is seen as being central to the development of a ‘competitive enterprise culture’ by focussing on ‘real world’ mathematics, personal finance and building links with business studies and work experience.

It is a measure of how individuals can contribute to society for the benefit of others. It is a different kind of caring.

Mathematics serves other subjects and its logic helps with problem solving. Sometimes it’s hard to see but if it is not there you know all about it.
Developing students’ confidence

Working on mathematics develops personal confidence. Having to justify their solutions or methods means that students cannot ‘hedge their bets’ or seek compromise agreements. All the headteachers regard mathematics as a way of developing confidence in students, especially in girls. This is not just restricted to the girls’ schools; the headteachers of the mixed schools feel that mathematics offers a forum where girls can challenge boys and gain in confidence. In many of the schools mathematics is recognised as being a hard subject, but through a system that celebrates perseverance as well as success, students gain in confidence. One headteacher felt that the fact that mathematics is hard is a really positive aspect of the subject and the school made a considerable effort to help the students develop the skills and the perseverance they need to work at problems over time. This emphasis on not always seeking easy instant solutions is seen by the school as being a way of developing an important life skill. In one school there is a ‘mathematician of the month’ prize where improvement was recognised as much as ability. Other schools run mathematics competitions, in some cases on a ‘league’ basis so that everyone can take part and gain from the experience.

Loving Mathematics

All the best schools emphasise the importance of developing a love of the subject. ‘Maths Weeks’ are organised in a number of schools where common themes such as crime or codes are explored. There is often an emphasis on enjoying the subject through puzzles, badges, mathematical jokes and in one school the teachers all wore sweatshirts with a puzzle on the back. Schools often make use of a network of plasma screens to get these common messages across to the whole school and help engage pupils in some of the activities. Doing mathematics as a subject in its own right – enjoying it for itself is valued and encouraged.

A rigorous discipline

The rigour that mathematics presents to students is welcomed, especially for boys. It is agreed that the competitive element in mathematics allows students to thrive. All the schools in the study value the hard-edged challenge that the subject offers students and welcome the opportunities presented to encourage students to undertake mathematical challenges and enter local and national mathematics competitions. In particular, the logic and rigour that underpins mathematics is valued as it offers a significantly different challenge to students when compared to other subjects. Many recognise that mathematics is hard and the fact that it demands more than just a cursory thought makes it challenging and worthwhile.
Mathematics and literacy

Mathematics is seen as a language in its own right; a way to communicate in symbols and diagrams. This type of communication is highly valued by the schools that have identified issues with either literacy or language. All of the headteachers recognise the part that mathematics plays in their strategies for dealing with literacy issues. Some feel that it offers a more universal language for students who do not share a common language. Others feel that it offers a chance for EAL students to develop a real level of success while they work on their English language skills.

What is most apparent from the case studies is that mathematics is valued for more than simply its contribution to the league tables. It is seen as a vital part of the students’ and the schools’ development and therefore recruiting, developing and sustaining an excellent mathematics department is seen as being crucial by all the schools in the study.
2. Recruiting teachers of mathematics

The Smith Report ‘Making Mathematics Count’ (The Stationary Office 2004) highlighted the shortage of specialist mathematics teachers nationally: a shortfall of 3400 in maintained secondary schools and 30% of mathematics teachers having no post A-level qualification in the subject. All the headteachers talked about the difficulties of recruiting the right teachers in mathematics, and it is clear that five years after Professor Smith’s report, the situation is still challenging. In the schools surveyed, all were fully staffed. This should be a very positive message for other schools who might be finding recruitment difficult: the schools surveyed had developed strategies that are very effective in meeting staffing challenges. One striking message came out from all the schools: always wait for the right person. All the headteachers were adamant that appointing staff simply because there was no one else is never an option.

Working with initial teacher training (ITT) institutions

Many of the schools feel that working with ITT institutions is a vital component of recruiting quality mathematics teachers. These schools train and support specialised mentors for ITT students. Time is allocated and protected for mentors to work closely with students during teaching practice and consequently the students feel well looked after and are often recruited into the school. Even if there is no vacancy available, students often return in later years to a promoted position having had an excellent initial experience of the school. It is felt that treating ITT students as full members of the teaching staff (even in small ways such as ensuring they have keys and if necessary a laptop) is important if they are to feel valued.

The benefits of giving ITT a high profile extend beyond the students themselves. The schools feel that mentors benefit from the training and contact with the HE institutions and become more reflective in their own practice as a result. This is often echoed within the department and the ITT students become a focus for the discussion of teaching and learning, encouraging all staff who engage with the students to become more reflective and collaborative.

Grow Your Own

In all of the schools, the mentoring programme extends beyond ITT students to include emerging teachers and newly qualified teachers (NQTs). The point is made that schools need to nurture and develop NQTs if they are to thrive and this induction programme in turn allows the schools to attract both Graduate Training Programme candidates and Teacher First teachers, both a rich source of promising mathematics teachers.
Many of the schools take this idea of nurturing new teachers to a much higher level. They proactively develop Higher Level Teaching Assistants (HLTAs) and cover supervisors by encouraging them to do Open University degrees and then feed them directly into teaching through the GTP. Without exception, teachers coming through this route were considered to be very high quality.

Two of the schools employ successful mathematics A-level students on gap years as Learning Assistants. These posts are employed imaginatively to support and enhance the work of the department and the opportunity is seen as being helpful in supporting students who might be considering teaching as a career path.

Some of the schools work with local universities on ambassador or associate programmes. The students on these programmes often request to return to the schools if they transfer to PGCE. If this is not possible they often ask to be informed of vacancies as and when they arise.

**Recruitment and governors**

The majority of schools feel that it is vital that governors are made aware of the difficulty in recruiting strong mathematics teachers and that at times it might be necessary to carry extra staffing in order to ensure that the department is fully staffed. The overstaffing is used in a variety of creative ways including intervention, encouraging collaborative practice and developing projects within the school. In one case, the mathematics department had been used to pilot the data handling and analysis for the school and was then used to work with other departments within the school to establish proper analysis; in another, extra staffing is used in a planned way for intervention at Year 9 and Year 11. Similarly, governors need to be made aware of the need to recruit excellent leaders within mathematics and that this might require recruitment on the leadership scale.

**The ethos of the department**

The majority of the schools feel that the strength, coherence and ethos of the mathematics department is a valuable asset in recruiting good teachers. Opportunities to develop managerial skills, to teach A-level, to take part in further study or join a national action research project were all cited as being helpful in attracting high quality applicants to the department. In many cases, simply joining a strong well resourced department where there is the opportunity to work with friendly, professional colleagues is a strong factor in choosing to apply.
There was a conscious effort to build the department and now it maintains itself but you always have to watch out for things like recruitment and retention.

Recruitment is regarded by all of the schools as a proactive process, rather than a reactive one. All of the headteachers are constantly aware of the likelihood of needing staff in the future for mathematics and are prepared to go to great lengths to secure the right staff. One headteacher makes regular trips to Ireland to recruit from ITT institutions with which she has built good relationships, while another works closely with overseas trained teachers, Teach First and Timeplan to ensure a good supply of mathematics teachers. All have a flexible and understanding approach to the use of part-time teachers.

The flexibility that part-time teachers offers the school is highly valued, as is the increased diversity they bring to the department. All of the headteachers are prepared to wait for the right candidate but all have strategies for filling the gaps in a positive way whilst waiting, often this involves the senior leadership team having a much more supportive hands-on role in the duration.
3. Retention

Revisiting a point made in the previous chapter, all the schools in the study were fully staffed. All the headteachers talked about the staff being their most valuable resource and retaining staff is an important aspect of maintaining a strong and stable department. However, headteachers also talked about the need to develop staff, building a momentum in the department which may well result in some staff moving on and this is seen as being part and parcel of running a vibrant mathematics department. Complete retention is not seen as being either practical or desirable. The overriding theme surrounding retention is one of valuing your staff. All agree that this is the most important issue in growing and developing a mathematics department. Many different strategies for achieving this are explored and are addressed in this section.

Performance management
The need for clearly negotiated targets and goals is considered by the schools to be very important. Performance management is not something to be ‘done to’ staff but rather represents collaborative and reflective practice between line managers and the department. Professional development is not seen as the province of weaker teachers but is regarded as an entitlement for all teachers to help them to grow. Many of the schools separate the developmental side of performance management from capability issues. In this way, clear opportunities are created in which staff can be praised and recognised for their work with the students and with one another. This process allows those responsible for mathematics to develop a shared vision of how the department could develop and how best its development could serve the overall progress of the school. This also allows the senior leadership team a real insight into the challenges, both national and local, facing the department. Equally, all of the headteachers can recount having to deal with staff who have pedagogic weaknesses as well as with those who had problems with their own subject knowledge. Performance management is regarded as a way of structuring help and support for these staff and working positively to improve their performance.

Resourcing
One clear way of valuing the staff is to give them the resources they need to do the job well. Everyone interviewed understands the pressures that mathematics and English departments are under and one way of dealing with this positively is to ensure that the staff get the support that they feel they need to make the required progress. The schools also make a concerted effort to create a positive working space for mathematics staff, which not only makes them feel valued but encourages collaborative and cooperative practice by placing them in physical proximity. In most of the schools, classrooms are well resourced; staff have laptops and access to good staff development. All of these are valued by staff and are seen by senior managers as one of the strategies that can be used to encourage staff to remain at the school.
Some of the schools actively support the mathematics department more favourably than other departments. This might manifest itself in terms of resources in the classroom whereas in some schools, salaries in the department were generous. One school has developed a comprehensive support structure to deal with administration and behaviour so that the teachers are ‘freed up to teach.’

Outside projects and higher degrees
Although this will also be dealt with in the CPD section, the importance of working outside the school is stressed by all of the schools in the context of staff retention. Working with external educational projects engages many of the staff creatively and gives them access to other professionals who can help them develop, as well as work on projects with the students. This is seen as a powerful device in retaining staff as they engage very deeply with teaching and learning and will be inclined to stay in order to see a project through. Second degrees are also encouraged for the same reason and it is felt that understanding and practical support when dissertation deadlines approach goes a long way in developing loyalty. Ultimately, both of the above can lead to a member of staff developing and deciding to leave the school. Nonetheless, it is felt that staff will stay longer and contribute more than they would otherwise have done. Not all staff can be retained but turnover can be cut down considerably. Another effect of working with outside agencies is that the staff feel successful and more positive about what they are doing.

Promotion
The schools encourage mathematics staff to apply for internal promotions within the school but sometimes outside the department. In many cases the mathematics staff have a teaching and learning responsibility (TLR) either within or external to the department. Although TLR posts outside the mathematics department can be seen as drawing staff away from a focus on the subject, it is felt that this is actually extremely positive with many benefits for the department. It offers an alternative route to promotion and helps to retain staff; it helps to spread the ethos of mathematics throughout the work of the whole school; real continuity is being developed as PGCE students become NQTs, develop as mathematics teachers and move on to more responsible positions; and the presence of a range of more experienced and senior staff within the department is seen as a real strength and hugely supportive to the mathematics subject leader. In addition, an awareness of succession planning is evident in some of the schools where careful thought has been given as to who could, and should, replace key mathematics staff when they leave. This is also a consideration in planning CPD. It is clear in most of the schools that there is a strategic approach to mathematics staffing, not a reactive one, and that this prevents shortages of qualified staff. One school ensures that every single member of the mathematics staff will be incredibly loyal and will stay if they feel valued and are given what they need to develop both themselves and their students.

The more successful the department becomes the more positive feeling grows and the more the staff put in. You need to kindle that feeling.

If everyone contributes then there is less to do and everyone can feel part of the achievement, teachers who are valued tend not to move.
department has some responsibility. This is seen as being extremely positive in helping to build expertise as well as developing a greater autonomy in the department. There is also a sense that teachers develop a greater responsibility for the direction and policy of the department, making management and leadership much more team oriented.

**Flexibility**

Schools feel that one key factor in retention is the ability to be flexible: it can be in relation to staff returning to work after having a child or in the run up to retirement or some other personal factor. Every headteacher interviewed feels that recognising and responding to a member of staff’s personal circumstances and making it possible for them to make a contribution, can lead to increased loyalty and a reluctance to move because they have found a positive working solution for their personal circumstances.

*We are all in this together.*
All the schools agree that high-quality CPD is essential in order to develop a good, strong mathematics department. There are many different approaches but the consensus is that CPD is not something to ‘be done’ to staff but rather it is a blend of approaches which serve to develop the provision of the subject over time. There are different categories of CPD used by the schools, including the development of classroom practice, subject knowledge and leadership. It is recognised that many of the staff coming into teaching may not have a mathematics degree and therefore subject knowledge development has to be considered as ongoing provision.

Bringing in ‘experts’
Many of the schools feel that it is a worthwhile investment to bring someone in to work with the whole department. Not only do the staff get a programme of professional development that is tailored to the needs of the department, but it can often encourage a more collaborative approach to professional development. Some of the schools make extensive use of the local borough consultant building links with other local schools. It was felt that professional development that is based on teaching and focussed on real classroom practice is particularly effective.

Working together
There is general agreement that working together collaboratively is one of the most effective forms of CPD that money can buy. How this is achieved varies. Several of the schools pay for either an ‘awayday’ or a residential weekend where staff work together on mathematics and teaching and learning. One school organises its timetable so that the department can meet together in school time every week. This is thought to be a very powerful device in creating and developing departmental vision and cooperation. Where overstaffing is sustained (see Section 3) it is often used to provide cover for peer observation and team teaching. Both are regarded as extremely effective modes of professional development.

Coaching
Many of the schools feel that coaching is an essential part of the professional development structure. In some schools, the coaching is informal; in one school it is organised in ‘triads’ of three teachers with one being more experienced. These arrangements are very often tied into peer observation schemes. Some schools also have professionally qualified coaches who work with specific staff on identified issues. In all these schools however, coaching is seen as being for all staff and is an entitlement for teachers.

Working with others from outside school
Projects and partnerships are mentioned by the schools as a powerful device for developing and extending staff. There is recognition that these can be costly in staff time and that support from the senior leadership in time and
Developing mathematics in Secondary Schools

resources is essential. However, in every school it is felt that the benefits far outweigh the costs. The changes in mathematics education are relentless and networking through other agencies helps to offset the stress on the system. Many of the schools engage with such projects as the Further Mathematics Network, More Maths Grads, the Ocean Project or the National Breakthrough Project and all the headteachers feel that the net result for the school is extremely beneficial. A number of schools have developed close working relationships with higher education institutions. In some cases this is a local ITT provider; in other it is a research based group such as the mathematics education department at Warwick University. In addition, several of the schools are Leading Edge Schools and the outreach work associated with this status is also felt to be extremely beneficial for the staff in terms of building confidence as well as management expertise and provides a wider range of professional experience.

A number of the schools emphasised the importance of networks. Heads of mathematics routinely meet with their counterparts in the area - usually organised through the National Strategy consultants. However, there were also a number of teachers who work with networks of other teachers through projects such as London Mathematics Challenge or those created by the NCETM. All were agreed that this form of collaborative professional development is very positive for the work of the department.

Working with others within school
The benefits of working with ITT students have already been discussed but it should be restated that this work is seen as being beneficial to the teachers as well as the students. It is felt by every school that having to articulate what is going on in the classroom encourages reflective practice and is of great benefit to the mentor. In addition, two schools have introduced a system of employing ‘gap year’ students. These students work in the mathematics department for a year between school and university and are trained by the staff to work in a variety of ways in the department. The process of training another person is regarded as excellent CPD for the trainer as well as the trainee.

Flexibility
Being flexible is regarded by all as essential. There is no one way which can be regarded as best practice in CPD and all the leaders feel that the blended approach works well. A number of the schools tie CPD tightly to performance management and are prepared for the staff to take control of what they perceive their departmental needs to be. Staff are encouraged to take control of their own CPD and to blend different approaches to maximise the benefit for the students, the school and for themselves.
5. Leadership and Management

Success in mathematics within a school depends on good teaching. However, to make the most of the resources available, this needs to be supported through good leadership and secure and effective management. Although the schools in the study range in size, structure and underlying nature; and sit within very different communities, it is striking to note a commonality of approaches that the leaders take in developing excellence in mathematics provision.

Communication
Clear channels of communication between senior leadership and the mathematics department are felt to be vital in developing the department. The appointment of the line manager for mathematics is felt to be a critical appointment as they should be able to relate to the subject and its demands. In many of the schools, the line managers of mathematics are actually mathematicians and this is felt to be beneficial. What is more important is that there are structured times for meetings and that these are adhered to. Good clear communication allows the senior leadership to forward-plan for staffing and succession and to make the mathematics staff realise that they have a voice and hence are valued. This is common to all of the schools. Equally, there is clearly good role modelling of communication going on within the school structure. Good communication between senior leadership and the subject leader is echoed in the good communication between the subject leader and mathematics staff. In some schools the communication structures are informal. However, even in these cases, there is an underlying system that has been well thought out. Communication, even in these cases, does not happen by chance.

Many of the schools have developed a series of strategies to ensure good communication within the department. Heads of mathematics often use email to communicate and request routine information. One head of department always sends out a departmental email every Monday morning. Many of the departments have weekly briefings to keep everyone up to date whilst other schools are developing their VLEs and starting to make use of it for this sort of communication. Some schools have developed mathematics staff handbooks to keep all the essential information in one place. Some heads of department emphasised the need to keep mathematics departmental meetings clear for teaching and learning and other more substantial issues.
Role Modelling
Role modelling is felt to be as important as communication. In three of the schools, the balance between business and reflective practice in meetings is clearly echoed throughout the meeting structure from senior leadership, through line manager and subject leader to departmental meetings. The pattern is one of increasing the time spent on reflective practice and cutting down the time spent on business in meetings.

Vision
All of the senior leaders interviewed articulate a vision of what they want their mathematics department to be. They are also clear that this is a shared vision with the staff, although it was not always shared at earlier parts of the journey. They have also thought through and could clearly articulate the strategies that they are using to move towards the vision. There is a very clear awareness by all the leaders interviewed that recruiting, developing and maintaining a good mathematics department is not an easy thing to do given the supply of mathematics teachers and the challenges facing them. However, there are also many different leadership strategies identified which can be used to overcome barriers and to build a department over time which will deliver the high quality teaching and learning required by the students. The schools studied are very different – they span a wide range of educational formats and the leadership styles are diverse. However, what is remarkable is that they identify very similar strategies for developing and sustaining their mathematics department. They all, without exception, regard the learning and teaching of mathematics as a high priority for the school and are prepared to commit the resources, both human and financial, to create a local solution to national challenges.
Next Steps

This report has raised many issues for dissemination and elaboration. There are also specific suggestions as to where future effort by the NCETM might most helpfully be directed.

**The NCETM will:**

- ensure that the good practice and expertise described in these case studies is disseminated nationally through the NCETM networks and portal and through appropriate partners;

- engage with key groups in school leadership, such as the National College of School Leadership, to take forward the messages to other headteachers and to aspiring headteachers;

- develop further links with senior school leadership, encouraging discussion and development of strategies for creating and sustaining a good mathematics department or workforce;

- continue to support ITT students, especially by providing easy access to high quality resources that support teaching and learning in mathematics;

- ensure that teachers of mathematics continue to have access to information on, and encouragement to participate in, a range of models of professional development that includes those with a focus that extends beyond a school’s immediate concerns;

- continue to develop local networks of practising teachers so that they feel both supported and challenged and have access to the many new resources which promote good mathematics teaching; we hope that other agencies will also take forward the important messages of this report and support headteachers in developing a vision for mathematics and an environment that nurtures the development of teachers of mathematics.
Appendix 1 Participating Schools

**Heathfield Community School**
Heathfield Community School is a specialist arts school with a secondary specialism in applied learning and Leading Edge status. It is an 11-19 school with approximately 1200 students and is situated in the village of Monkton Heathfield, near Taunton in Somerset.

The school draws students from the nearby market town of Taunton and the surrounding rural area. The proportion of students entitled to free school meals is broadly average. There are very few students from minority ethnic groups or with a first language other than English. The school campus includes a well-equipped performing arts centre which is managed jointly by the school and the Tacchi-Morris Trust.

**Matthew Moss High School**
This is an average size school serving an area of challenging social and economic circumstances. The school holds Leading Edge and Training School status. It was designated a specialist science college in September 2007.

The numbers of students from minority ethnic groups and those for whom English is an additional language are well above average. The proportion of students entitled to free school meals is also higher than usual. The proportion of students with learning difficulties and/or disabilities, including those with a statement of special educational need, is above average.

**Mulberry School for Girls**
Mulberry school is an 11-18 comprehensive for girls in the London Borough of Tower Hamlets. It has 1400 students with 400 in the sixth form. It is a Leading Edge School and a Specialist Arts College.

The students are nearly all of Bangladeshi heritage and most speak English as an additional language with a high number at an early stage of English language acquisition. The proportion of students entitled to free school meals is five times the national average.

**Plashet School**
Plashet School is an 11-16 girls comprehensive in the London Borough of Newham. It has 1350 students on role and is a Leading Edge School.

The students are predominately from ethnic minority backgrounds and nearly all of them speak English as an additional language. The proportion of students eligible for free school meals is well above average.
Robert Clack School
Robert Clack School is an 11-18 mixed comprehensive in the London Borough of Barking and Dagenham. It has 1750 students on role with 270 in the sixth form. The school is a specialist science college which has recently achieved a second specialism in mathematics and computing. It is also a teaching hub for Further Mathematics within Barking and Dagenham.

The majority of students are White British. A larger than average proportion of students is eligible for free school meals and there is a larger than average proportion of students with learning difficulties and/or disabilities which include statements of special educational needs. The school serves an area containing significant deprivation; its intake is drawn from two of the most disadvantaged wards in the country.

St Angela’s Ursuline School
St Angela’s is a Catholic 11-18 comprehensive school for girls in the London Borough of Newham. It has 1350 students on role and shares and very large sixth form of nearly 700 students with a boys’ Catholic school. It is a Leading Edge school and is also a Specialist Science and Technology College.

The majority of students in the school are Catholic, but there are some students from other faiths. More than 80% of the students are from minority ethnic groups, with the largest group, about a third, from Black African backgrounds. A large number of languages are spoken by the students and the proportion of students with learning difficulties is broadly average. About a fifth of the students are eligible for free school meals and most come from an area where the level of deprivation is very high.

St Bede’s Catholic School and Sixth Form College
St Bede’s is a large 11-19 Roman Catholic school which became a specialist language college in 1998. A very small minority of students in the sixth form join in Year 12 from other schools. The school is located in the north west of County Durham.

The students come from a variety of social and economic backgrounds. There are few students in the school without English as their first language or from minority ethnic groups. The number of students with learning difficulties and/or disabilities is a third below the national average.
**Seven Kings High School**

Seven King’s High School is an 11-18 mixed comprehensive in the London Borough of Redbridge. It has 1350 students with 420 in the sixth form. It is a Leading Edge school and is a Specialist Science and Technology College with and additional specialism of languages.

The school serves a diverse community with many students of minority ethnic heritage. Approximately 75% of the students speak English as an additional language. The number of students who have learning difficulties is broadly average and the school has a specialist centre for children with physical disabilities.

**Sidney Stringer School**

Sidney Stringer School is an 11-18 mixed comprehensive school near Coventry city centre with 1250 students. It has a culturally rich and diverse population: four fifths of pupils come from minority ethnic backgrounds and over 70% are bilingual. The number of pupils with learning difficulties and disabilities is well above average. The percentage of students entitled to free school meals and the number of transient students are well above the national average. The school was designated as a mathematics and computing specialist school in 2004 and became a High Performing Specialist School in 2008.

**Sir John Cass Foundation and Redcoat Church of England Secondary School**

Sir John Cass School is an 11-18 voluntary aided Church of England mixed comprehensive in the London Borough of Tower Hamlets. It has 1370 students with 460 in the sixth form and is a specialist Languages and Business Enterprise College.

The school is located amongst areas of high deprivation. Over 90% of students are from minority ethnic groups, with two thirds from Bangladeshi backgrounds. 80% of students are classified as bilingual and the school supports a significant number of students in the early stages of learning English and has a significant number of students with refugee status.
Stafford Sports College
Stafford Sports College is a small secondary school serving students largely from the Manor and Penkside areas of Stafford. It is an 11-18 school with sixth formers being taught as part of a collegiate. The college gained specialist status for sport in 2005.

Slightly above average numbers of students are eligible for free school meals. The vast majority of students are of White British heritage and about 5% come from a range of ethnic backgrounds. The college has about double the national average proportion of students with learning difficulties and/or disabilities. The proportion of students with a statement of special educational need is about a third above the national average.

Stepney Green Mathematics and Computing College
Stepney Green School is an 11-16 boys comprehensive school in the London Borough of Tower Hamlets. It has 760 students and is a Specialist Mathematics and Computing College.

The vast majority of students are from Bangladeshi heritage and a very high proportion speak English as an additional language. The school works in challenging circumstances. The proportion of children eligible for free school meals is four times the national average and many of the students come from backgrounds that can be considered economically disadvantaged.

The Thomas Hardye School
The Thomas Hardye School is a larger-than-average 13-19 comprehensive with a very large sixth form, serving the county town of Dorchester and the surrounding villages. The school is over-subscribed and the roll has increased substantially in recent years, particularly in the sixth form. The school has been a specialist science college since 2002 and has recently been awarded two more specialisms in humanities and special educational needs.

There are very few students from minority ethnic backgrounds or with a first language other than English. The number of students who have free school meals or who have special educational needs is lower than nationally. There is a specialist unit attached to the school for students with speech and language difficulties. The school also caters for students with physical disabilities from across west Dorset.
West Exe Technology College

West Exe Technology College is a larger than average 11-16 comprehensive school. In September 2006, the college moved to new buildings built on the college site. The college has been a specialist Technology College since 1996 and gained two additional specialisms in Applied Learning and Leading Edge in April 2007. The college has attained Artsmark, Sportsmark, Investors in People Award, Investors in Careers Award and Investors in Enterprise and Work Related Learning.

The college has an off-site inclusion unit which provides a learning centre for Key Stage 4 students with extra needs. Most students are from a White British background and the number of students whose first language is not English is low for a school of this size. The proportion of students with learning difficulties and/or disabilities is similar to the national average. The percentage of students with a statement of special educational needs is below average. The most commonly identified of these needs relate to emotional and behavioural difficulties.
Appendix 2 Top Tips

Many different ideas and strategies were outlined during the structured interviews of the case study. Not all of them could be discussed in detail. Listed below are some of the things that have worked well for different the schools who took part in the study. They are not in any particular order of importance and it is not an exhaustive or exclusive list. Obviously not all can be tackled at once. They are intended to provide some ideas which will help others think about how best to support and improve the development of the mathematics department of their school.

In order to raise the profile of mathematics within your schools you can:

- have assemblies, in which mathematics plays a major role – perhaps how it is used in different professions, looking at statistics and what they show us about the world in which we live;
- enter or run mathematics competitions;
- recognise achievement and perseverance in mathematics by making awards for mathematician of the week;
- create displays which are visually striking, informative and may even be interactive. The message given should be that mathematics is multifaceted useful and fun. If you have a plasma display system use it to promote puzzles, problems, challenges;
- make it fun! Badges, loyalty cards for attending workshops, displays with interesting but funny facts eg ‘Did you know that....’;
- run a maths week involving everyone, not just students. Making the department the focus will help everyone to ‘step up’ their game;
- encourage maths to play a major part in cross curricular projects or consider teaching maths in another language;
- use the skills of the department to help with data handling;
- have a well thought out strategy for early entry which enhances students’ development rather than addressing government statistics;
- have maths trips eg Mechanics and Alton Towers, Time and Greenwich, maths trails;
- invite experts to come to the school to work with students focussing on the relevance and use of mathematics; for example: mathematicians, astronomers, engineers, bankers, designers;
- write maths newsletters for staff, students and/or parents;
- encourage students to read about the subject. For example: library projects, reading articles for homework or looking for maths in the media.
In order to raise the chances of recruiting high quality mathematics teaching staff you can:

- form very close and productive relationships with ITT institutions;
- look after your ITT students very well, they may want to stay or come back to your school in later years;
- make your staff are aware of the need to look after ITT students well and ensure time is given to them to do that, use the ITT institutions to help train your mentors;
- only appoint a mathematics teacher if you are sure that they are right for the post;
- be prepared to overstaff and to use that slack in the system creatively;
- work with your governors to ensure that they understand how difficult it is to recruit mathematics teachers;
- promote your school and the mathematics department. Be welcoming and open;
- provide good working conditions for staff. Ensure that they have the tools to do the job well eg a laptop, good resources;
- spot talent in your own staff eg retrain PE teachers who show interest in mathematics;
- spot talent and interest in HLTA or cover supervisors, be prepared to support them in gaining a degree and into the GTP;
- be flexible on pay and conditions and consider the benefits of part time teachers
- provide a supportive induction programme;
- be proactive in seeking candidates – don’t just wait for a vacancy to happen – be prepared to take a gamble that someone will leave but also be prepared to use the over staffing well.

In order to retain staff you can show them that they are valued by:

- ensuring that performance management is a reflective and collaborative process;
- giving teachers the resources that they need to do their job well;
- listening to the opinions of teachers and making them aware that you are doing so;
- making sure that their working environment is as good as you are able to make it;
- paying attention to the little details like good coffee in the staffroom;
- supporting staff in admin and behaviour – let your teachers teach;
- encouraging a culture of celebration e.g. recognising new successful developments or a piece of good practice;
- ensuring that their personal development is high on the agenda;
- praising good practice;
- making lesson observations a formative process rather than a summative one – scoring an observation does not help someone develop.
You can also retain staff by:

- encouraging them to take on new projects;
- giving them time to work on these projects;
- good clear succession planning from ITT to NQT, NQT to TLR, TLR to HoD, HoD to senior leader;
- accepting that sometimes development will lead to staff leaving the school;
- creating internal promotion opportunities sometimes outside the department;
- creating new projects or roles;
- being flexible in responding to personal circumstances;
- encouraging study of higher degrees;
- using bursaries for new projects thus allowing you to keep the staffing structure intact but at the same time rewarding and retaining staff.

You can create a blended programme of CPD by:

- working with neighbouring schools to share expertise;
- developing staff by encouraging them to develop others;
- arranging a regular time for the mathematics department to work together;
- ensuring the department has a good working space in which they can work collaboratively
- peer observations;
- coaching triads;
- developing coaching expertise with the department which might include the training of a teacher as a professional coach;
- encouraging higher degrees or professional qualifications;
- getting in ‘experts’ to tailor make sessions to staff requirements;
- working closely with LA consultants;
- encouraging staff to work on national projects;
- collaborative planning;
- encouraging all staff to take responsibility for others eg ITT students or gap year students;
- encouraging and expecting staff to reflect upon their own teaching and that of others;
- encouraging staff to take professional risks through developing a more reflective ‘no blame’ culture;
- encouraging staff to go out from school on courses, to see other schools and to work with colleagues from different schools;
- insisting on departmental meetings having a teaching and learning agenda;
- arranging for staff to shadow other colleagues;
- working closely with local universities;
• working closely with local industries;
• ensuring that everyone is entitled to CPD and that each teacher has a full say in what they need to grow and develop.

In order to aid communication with and within the mathematics department you can:
• have regular structured meetings between the Head of Mathematics and the line manager;
• be ‘around’ and be involved and interested;
• group mathematics classrooms close together and close to a workroom;
• provide a space where staff can work together and plan collaboratively;
• organise a system of structured interviews for everyone. Make the performance management an opportunity to praise staff;
• make sure the staff can have their say and that the Head of Mathematics can feed their comments and views in the SLT arena;
• monitor student work and marking and follow up with constructive feedback;
• ensure meetings are efficient and well structured;
• create an underlying structure for informal communication;
• discuss goals and visions – create a structure to ensure that this takes place;
• hold mathematics briefings;
• have a noticeboard in the workroom with a developed calendar, deadlines and events;
• have open door classrooms;
• use examination reviews as a time to look forward as well as back;
• timetable weekly meetings for the department;
• encourage brief and functional departmental bulletins to deal with everyday matters;
• encourage departmental newsletters for students with news information and challenges;
• encourage good wall displays and use of the plasma information screens – if available.
www.ncetm.org.uk

A Department for Children, Schools and Families initiative to enhance professional development across mathematics teaching.